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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/756,122	01/13/2004	Wai-Fan Yau	AMAT/2592.C7/DSM/LOW K/JW	4554
44257	7590	06/17/2005	EXAMINER MALDONADO, JULIO J	
MOSER, PATTERSON & SHERIDAN, LLP APPLIED MATERIALS, INC. 3040 POST OAK BOULEVARD, SUITE 1500 HOUSTON, TX 77056			ART UNIT 2823	PAPER NUMBER

DATE MAILED: 06/17/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/756,122

Applicant(s)

YAU ET AL.

Examiner

Julio J. Maldonado

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 March 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3,5-13,15-18 and 21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3,5-13,15-18 and 21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>20050323</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. The rejection as set forth in Office Action mailed on 02/23/2005 is withdrawn in view of applicants' amendments filed on 03/23/2005.
2. Applicants' cancellation of claims 4, 14, 19 and 20 and addition of claim 21 is acknowledged.
3. Claims 1-3, 5-13, 15-18 and 21 are pending in the application.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1, 2, 6, 7 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sugahara et al. (U.S. 5,989,998) in view of the following comments.

Sugahara et al. (Figs.3a-3d) teach a method of forming an interconnect structure including the steps of depositing a layer of silicon nitride (201) over a substrate (200); forming a layer of oxidized organosilane (organic silicon oxide) layer (202) over the silicon nitride layer (201); forming a second layer of silicon nitride (203); forming a second layer of oxidized organosilane layer (204) on the second layer of silicon nitride (203); wherein the first nitride layer, first organosilane layer, second nitride layer and second organosilane layer constitutes a dielectric stack; etching the dielectric stack using common photolithographic etching procedures to form a hole (205, 206); and forming interconnect structures (208, 209) in the hole (205, 206), wherein said

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organosilane layers has a carbon content of, for example, of 25.7% (embodiment 1, chemical formula 2) or 22.2% (ninth embodiment, chemical formula 15), wherein the low dielectric constant oxidized organosilane layer is deposited in the presence of RF power from a mixture comprising an organosilane compound including the structure C-Si-H, an oxidizing gas and furthermore can include a fluorinating agent, wherein the organosilane compound includes the structure R_xSiH_{4-x} , wherein R is a phenyl group and x is an integer of 1 to 3 and wherein all of the embodiments of the invention are performed in a plasma CVD apparatus (column 7, line 66 – column 8, line 34, column 8, line 58 – column 11, line 53 and column 18, line 25 – column 21, line 53).

Sugahara et al. fail to teach wherein the carbon content of the low dielectric constant oxidized organosilane layer is from 1% to 50%. However, in the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a prima facie case of obviousness exists. MPEP 2144.05. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the organosilane layers disclosed in Sugahara et al. to arrive to the claimed invention.

Still Sugahara et al. fail to expressly teach wherein the dielectric constant of the low dielectric constant oxidized organosilane layer is about 3.0. However the same materials are treated the same way and thus the same result would be obtained. Therefore, Sugahara et al. teach upon the claimed limitation.

6. Claims 3 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sugahara et al. (U.S. 5,989,998) as applied to claims 1, 2, 6, 7 and 9-13 above, and further in view of Matsuura (U.S. 6,124,641).

Sugahara et al. substantially teach all aspects of the invention but fail to disclose wherein the organosilane compound is methylsilane and wherein the oxidizing gas is N_2O . However, Matsuura in a related method of reducing the dielectric constant silicon oxide layer teaches depositing an oxidized organosilane layer (organic silicon oxide) formed by reacting an organosilane compound such as methylsilane and vinyl silane with oxidizing agents, wherein said oxidizing agents include N_2O and H_2O_2 (column 2, line 57 – column 4, line 29). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Sugahara et al. and Matsuura to enable forming in organic silicon oxide layer in Sugahara et al. to be performed according to the teachings of Matsuura because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of forming the organic oxide layer of Sugahara et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

7. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sugahara et al. (U.S. 5,989,998) as applied to claims 1, 2, 6, 7 and 9-13 above, and further in view of Jeng et al. (U.S. 5,780,338).

Sugahara et al. teach etching said oxidized layer to form a contact hole (Sugahara et al., column 8, line 64 – column 9, line 7) but fail to teach etching said oxide using fluorine, carbon and oxygen ions. However, Jeng et al. teach a method of etching low dielectric oxidized organosilane layer using fluorine, carbon and oxygen ions using photolithography (column 7, lines 28 – 54). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine

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the teachings of Sugahara et al. and Jeng et al. to enable etching the dielectric layer of Sugahara et al. according to the teachings of Jeng et al. for the further advantage of extending the resolution of the photolithography (column 7, lines 46 – 49).

8. Claims 15-18 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sugahara et al. (U.S. 5,989,998) in view of Matsuura (U.S. 6,124,641).

Sugahara et al. (Figs.3a-3d) teach a method of forming an interconnect structure including the steps of depositing a layer of silicon nitride (201) over a substrate (200); forming a layer of oxidized organosilane (organic silicon oxide) layer (202) over the silicon nitride layer (201); forming a second layer of silicon nitride (203); forming a second layer of oxidized organosilane layer (204) on the second layer of silicon nitride (203), wherein the first nitride layer, first organosilane layer, second nitride layer and second organosilane layer constitutes a dielectric stack; etching the dielectric stack using common photolithographic etching procedures to form a hole (205, 206); and forming interconnect structures (208, 209) in the hole (205, 206), wherein said organosilane layers has a carbon content of, for example, of 25.7% (embodiment 1, chemical formula 2) or 22.2% (ninth embodiment, chemical formula 15), wherein the low dielectric constant oxidized organosilane layer is deposited in the presence of RF power from a mixture comprising an organosilane compound including the structure C-Si-H, an oxidizing gas and furthermore can include a fluorinating agent, wherein the organosilane compound includes the structure R_xSiH_{4-x} , wherein R is a phenyl group and x is an integer of 1 to 3 and wherein all of the embodiments of the invention are

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performed in a plasma CVD apparatus (column 7, line 66 – column 8, line 34, column 8, line 58 – column 11, line 53 and column 18, line 25 – column 21, line 53).

Sugahara et al. fail to teach wherein the carbon content of the low dielectric constant oxidized organosilane layer is from 1% to 50%. However, in the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a prima facie case of obviousness exists. MPEP 2144.05. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the organosilane layers disclosed in Sugahara et al. to arrive to the claimed invention.

Sugahara et al. substantially teach all aspects of the invention but fail to disclose wherein the organosilane compound is methylsilane. However, Matsuura in a related method of reducing the dielectric constant silicon oxide layer teaches depositing an oxidized organosilane layer (organic silicon oxide) formed by reacting an organosilane compound such as methylsilane and vinyl silane with oxidizing agents and wherein said oxidizing agents include N_2O and H_2O_2 (column 2, line 57 – column 4, line 29). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Sugahara et al. and Matsuura to enable forming in organic silicon oxide layer in Sugahara et al. to be performed according to the teachings of Matsuura because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of forming the organic oxide layer of Sugahara et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Response to Arguments

9. Applicant's arguments filed 03/23/2005 have been fully considered but they are not persuasive.

Applicants argue, "...Sugahara et al. does no teach or suggest depositing a low dielectric constant oxidized organosilane layer in a plasma enhanced process from a mixture comprising an organosilane compound and an oxidizing gas...". In response to this argument, Sugahara et al. teach forming a low dielectric silicon oxide, using organic silicon having the general formula $R^1_xSiH_{4-x}$, wherein in one of the embodiments of the invention said organic silicon undergoes a plasma polymerization (e.g., column 11, lines 26 – 59). It is inherent that in this embodiment, in order to form the polymer described by Sugahara et al., there has to be an oxidizing agent during said plasma polymerization. Therefore, Sugahara et al. teach upon the claimed limitation.

Also, applicants argue, "...Sugahara et al. teaches away from depositing a film using a methylsilane compound...there is no motivation to use the methylsilane precursors provided by Matsuura to deposit films comprising Si-CH₃ bonds in Sugahara". In response to this argument, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Sugahara et al. teach using silicon organic compounds

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including vinyl silane. Having this in mind, Matsuura teaches depositing an oxidized organosilane layer (organic silicon oxide) formed by reacting an organosilane compound such as methylsilane and vinyl silane with oxidizing agents and wherein said oxidizing agents include N_2O and H_2O_2 (column 2, line 57 – column 4, line 29). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Sugahara et al. and Matsuura to enable forming an organic silicon oxide layer in Sugahara et al. to be performed according to the teachings of Matsuura because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of forming the organic oxide layer of Sugahara et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

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11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.

12. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax number for this group is 703-872-9306 for before final submissions, 703-872-9306 for after final submissions and the customer service number for group 2800 is (703) 306-3329.

Updates can be found at <http://www.uspto.gov/web/info/2800.htm>.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
June 13, 2005


George Fourson
Primary Examiner